PATENT ABSTRACTS OF JAPAN

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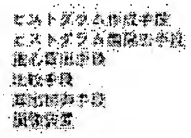
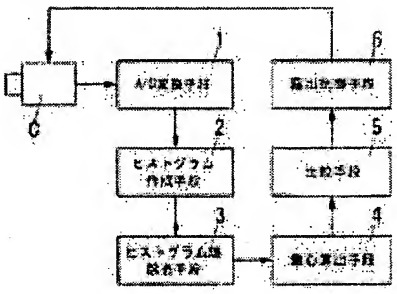
(54) METHOD AND DEVICE FOR EXPOSURE CONTROL

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a method and device for exposure control, which can reduce the processing loads.
SOLUTION: The method and device comprise a histogram creating means 2 for creating a histogram of the values of each pixel of an imaging device C, which is equipped with an image sensor having a plurality of pixels and can adjust exposure; a histogram edge removing means 3 for removing parts of the histogram; a centroid calculation means 4 for calculating the centroid of the histogram; a comparison means 5 for calculating the direction and the size of the shifting of the histogram's centroid from a predetermined reference range; and an exposure control means 6 for controlling the exposure so that the centroid falls within the reference range, based on the direction and size calculation. Since the frequencies of the operations required for calculating the centroid can be made fewer than those required for calculating the average value of pixel output for one screen, processing loads can be reduced, as compared with the case where the average value of pixel output for one screen is used for control.





* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1]
It is an exposure controlling method which is provided with an image sensor which has two or more pixels, and controls exposure of an imaging device which can adjust exposure, Create a histogram of a pixel value of an image sensor and the center of gravity of said histogram is computed, An exposure controlling method controlling exposure so that the center of gravity of said histogram enters in said reference interval based on direction and a size of a gap of the center of gravity of said histogram to a reference interval set up beforehand.
[Claim 2]
The range of the maximum decided in an imaging device of a pixel value before computing the center of gravity of said histogram to constant width, and the exposure controlling method according to claim 1 with which a pixel value is characterized by removing at least one side with the range of constant width from said histogram from 0.
[Claim 3]
An exposure controller which is provided with an image sensor which has two or more pixels, and controls exposure of an imaging device which can adjust exposure, comprising:
A histogram preparing means which creates a histogram of a pixel value of an image sensor.
A centroid calculation means to compute the center of gravity of said histogram.
A comparison means to compute direction and a size of a gap of the center of gravity of said histogram to a reference interval set up beforehand.
An exposure control means which controls exposure so that the center of gravity of said histogram enters in said reference interval based on direction and a size of a gap of the center of gravity of said histogram to said reference interval.

[Claim 4]
A range and a pixel value of constant width are provided with a histogram end elimination means which removes at least one side with the range of 0 to constant width from said histogram from the maximum decided in an imaging device of a pixel value, The exposure controller according to claim 3, wherein said centroid calculation means computes the center of gravity of said histogram which said histogram end elimination means outputted.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]
This invention relates to the exposure controlling method and exposure controller which are provided with the image sensor which has two or more pixels, and control exposure of the imaging device which can adjust exposure.
[0002]

[Description of the Prior Art]
As an exposure controlling method which is provided with the image sensor which has two or more pixels from the former, and controls exposure of the imaging device which can adjust exposure, The exposure controlling method which controls exposure so that the average of the stroke region of the luminance signal (it is only hereafter called "the output which is a pixel") which a pixel outputs approaches a reference value is proposed (for example, refer to the patent documents 1 and patent documents 2).
[0003]
The average Iaverage of the output of the pixel of one screen was computed by the lower formula 1, for example using the arithmetic unit.
[0004]
[Equation 1]

$$Iaverage = \frac{\sum_{k=1}^{K\max}\sum_{m=1}^{M\max} I(k,m)}{K\max \times M\max} \quad \cdots \quad (式1)$$

[0005]
However, as shown in drawing 4, the pixel number to which Kmax was located in a line with the length of the image sensor, the pixel number to which Mmax was located in a line beside the image sensor, and I (k, m) are the outputs of the left to the k-th and the m-th pixel P from a top. That is, the output of a pixel is added and the average Iaverage of the output of the pixel of one screen is computed by breaking by pixel number KmaxxMmax. In the image sensor (CCD element) of the imaging device (CCD camera) generally used, for example by the intercom with a camera, it is Kmax=240 and Mmax=320.
[0006]
[Patent documents 1]
JP,H5-207361,A (the 4th page)
[Patent documents 2]
JP,H6-46325,A (the 6th page)
[0007]
[Problem(s) to be Solved by the Invention]
However, in the above-mentioned conventional exposure controlling method, in order to compute the average of the output of the pixel of one screen, it is necessary to calculate the same number of times as a pixel number. In the case of the imaging device mentioned as the example in the top, a total of 76800 operations is [addition] needed for a time (240x320-1) and division at once. Therefore, big load was applied to the arithmetic unit, control of exposure became slow, and the flattery nature to change of a picture was getting worse.
[0008]
This invention is made in view of the above-mentioned reason, and the purpose is to provide the exposure controlling method and exposure controller which can reduce a processing load.
[0009]
[Means for Solving the Problem]
An invention of Claim 1 is an exposure controlling method which is provided with an image sensor which has two or more pixels, and controls exposure of an imaging device which can adjust exposure, A histogram of a pixel value of an image sensor is created, the center of gravity of said histogram is computed, and exposure is controlled so that the center of gravity of said histogram enters in said reference interval based on direction and a size of a gap of the center of gravity of said histogram to a reference interval set up beforehand.
[0010]
Before an invention of Claim 2 computes the center of gravity of said histogram in the invention according to claim 1, the range of the maximum decided in an imaging device of a pixel value to

constant width and a pixel value remove at least one side with the range of 0 to constant width from said histogram.

[0011]

Exposure controller of this invention which is provided with an image sensor for which it has two or more pixels, and controls exposure of an imaging device which can adjust exposure is characterized by that an invention of Claim 3 comprises the following.

A histogram preparing means which creates a histogram of a pixel value of an image sensor.

A centroid calculation means to compute the center of gravity of said histogram.

A comparison means to compute direction and a size of a gap of the center of gravity of said histogram to a reference interval set up beforehand.

An exposure control means which controls exposure so that the center of gravity of said histogram enters in said reference interval based on direction and a size of a gap of the center of gravity of said histogram to said reference interval.

[0012]

An invention of Claim 4 is provided with a histogram end elimination means in which a range and a pixel value of constant width remove at least one side with the range of 0 to constant width from said histogram in the invention according to claim 3 from the maximum decided in an imaging device of a pixel value, Said centroid calculation means computes the center of gravity of said histogram which said histogram end elimination means outputted.

[0013]

[Embodiment of the Invention]

Hereafter, an embodiment of the invention is described based on Drawings.

[0014]

This embodiment is what is provided with the image sensor which has two or more pixels, and controls exposure of the imaging device C (for example, CCD camera) which can adjust exposure, as shown in drawing 1, The A/D conversion means 1 which carries out the A/D conversion of the output of each pixel of the imaging device C, and the histogram preparing means 2 which creates a histogram based on the output of the A/D conversion means 1, The histogram end elimination means 3 which removes a part of histogram, and a centroid calculation means 4 to compute the center of gravity of a histogram, It has the exposure control means 6 which controls exposure so that the center of gravity of a histogram approaches a reference value based on a comparison means 5 to compute direction and size of the gap of the center of gravity of a histogram to the reference interval set up beforehand, and direction and size of the gap of the center of gravity of a histogram to a reference interval. The histogram preparing means 2, the histogram end elimination means 3, the centroid calculation means 4, the comparison means 5, and the exposure control means 6 are realized by arithmetic unit respectively like a microcomputer.

[0015]

If it explains in detail, the A/D conversion part 1 will carry out the A/D conversion of the output of each pixel, and will generate a pixel value. A pixel value is a discrete value corresponding by the maximum of the output of the pixel decided in the imaging device C from 0, for example, takes the integral value of 0–255. The histogram preparing means 2 creates the histogram which shows the pixel number to a pixel value as shown in drawing 2 (a).

[0016]

As the 2nd beforehand bigger threshold H than the 1st threshold L and the 1st threshold L is set to the histogram end elimination means 3 and it is shown in drawing 2 (b), a pixel value The range to the 0 to 1st threshold L, The range from the 2nd threshold H to the maximum (for example, 255) of a pixel value is removed from a histogram. Here, the 1st threshold L and the 2nd threshold H are set up according to the situation of the setting position of the imaging device C, etc. remain without removing the range of the high pixel value of a possibility of corresponding to a photographic subject.

[0017]

It is good also as composition which sets up the range to remove automatically periodically for

every photography instead of setting up the 1st threshold L and the 2nd threshold H beforehand. For example, make into the 1st threshold L the position of the valley in the position whose pixel value is higher than the peak in a position with the lowest pixel value, and let the position of the valley in the position whose pixel value is lower than the peak in a position with the highest pixel value be the 2nd threshold H.

[0018]

The centroid calculation means 4 computes center-of-gravity I_0 (refer to drawing 2 (c)) of the histogram which the histogram end elimination means 3 outputted by the lower type 2.

[0019]

[Equation 2]

$$I_0 = \frac{\sum_{i=L+1}^{H-1} i \cdot N(i)}{\sum_{i=L+1}^{H-1} N(i)} \quad \cdots \quad (式2)$$

[0020]

Here, N(i) is the number of the pixels which take the pixel value i.

[0021]

The comparison means 5 computes direction and size of a gap of center-of-gravity I_0 to the reference interval where the lower limit A1 and the upper limit A2 were set up beforehand, as shown in drawing 2 (d). For example, when center-of-gravity I_0 is lower than the lower limit A1 of a reference interval, the difference W of the lower limit A1 and center-of-gravity I_0 is computed.

[0022]

The exposure control means 6 controls exposure by controlling the amount of diaphragms and shutter speed of the imaging device C so that center-of-gravity I_0 enters in a reference interval.

[0023]

A result of having controlled based on center-of-gravity I_0 of a histogram shown in drawing 3 (b) which standardized and operated orthopedically so that both ends of a histogram shown in drawing 3 (a) might be removed in an experiment which an artificer conducted and the maximum of a pixel number might be set to 1, A histogram shown in drawing 3 (c) was obtained, and rationalization of exposure was checked.

[0024]

According to the above-mentioned composition, an operation performed after all for calculation of an arithmetic unit as the centroid calculation means 4 of the center of gravity to accumulate, Since it is with addition about [which was set as a pixel value to multiplication about / which was set as a pixel value to a numerator of the formula 2 / a number, and a numerator and a denominator of the formula 2, respectively] a number, and one division, the number of times of a required operation will be a number of at most about 3 times set as a pixel value in total. If about 256 steps of 0-255 are set to a pixel value as a result of an experiment which an artificer conducted, it turns out that the exposure control effect equivalent to a conventional method of averaging an output of a pixel of one screen is acquired. In that is, the case of an image sensor which has a pixel of about 100,000-300,000 like an image sensor carried in an imaging device used, for example by an intercom with television. An operation which an arithmetic unit used for this invention performs as the centroid calculation means 4 will not fulfill 1000 times with a conventional method of averaging an output of a pixel of one screen in total to performing about 100,000 times - 300,000 operations, either. Since histogram creation is the light processing of a grade which can be performed also with a cheap arithmetic unit, a processing load is reduced

synthetically.
[0025]
Therefore, when a burden to an arithmetic unit decreases, control of exposure accelerates, Since flattery nature to change of a luminosity of a picture improves, it is suitable for imaging devices installed in environment where a luminosity of a picture changes easily, such as a camera, a camera of an intercom with television, a surveillance camera, etc. which are installed in the door of collective housing, such as an apartment. Or though flattery nature equivalent to the former is maintained, cost can be lowered using an arithmetic unit of a low speed cheaper than an arithmetic unit used conventionally. A required memory decreases by reducing a processing load.
[0026]
Since the histogram end elimination means 3 is established, a phenomenon in which a photographic subject carries out black crushing when an extremely bright field exists in a screen, a phenomenon in which a photographic subject white-flies when an extremely dark field exists in a screen, etc. are prevented, and more suitable exposure control is attained. Since the number of times of an operation for computing the center of gravity of a histogram compared with a case where the histogram end elimination means 3 moreover is not established when width of a histogram becomes narrow becomes fewer, a processing load is reduced further.
[0027]
[Effect of the Invention]
The invention of Claim 1 is an exposure controlling method which is provided with the image sensor which has two or more pixels, and controls exposure of the imaging device which can adjust exposure, Create the histogram of the pixel value of an image sensor and the center of gravity of said histogram is computed, Since exposure is controlled so that the center of gravity of said histogram enters in said reference interval based on direction and size of the gap of the center of gravity of said histogram to the reference interval set up beforehand, The number of times of an operation required for calculation of the center of gravity of a histogram can be made less than the number of times of an operation required for calculation of the average value of the output of the pixel of one screen, And since histogram creation is the light processing of a grade which can be performed also with a cheap arithmetic unit, it can reduce a synthetic processing load compared with the case where the average value of the output of the pixel of one screen is used for control.
[0028]
The range of the maximum decided in the imaging device of a pixel value before the invention of Claim 2 computes the center of gravity of said histogram in the invention according to claim 1 to constant width, From 0, since a pixel value removes at least one side with the range of constant width from said histogram, The phenomenon in which a photographic subject carries out black crushing when an extremely bright field exists in a screen, the phenomenon in which a photographic subject white-flies when an extremely dark field exists in a screen, etc. are prevented, and more suitable exposure control is attained. Since the number of times of the operation for computing the center of gravity of a histogram when the width of a histogram moreover becomes narrow becomes fewer, a processing load is reduced further.
[0029]
The histogram preparing means which the invention of Claim 3 is an exposure controller which is provided with the image sensor which has two or more pixels, and controls exposure of the imaging device which can adjust exposure, and creates the histogram of the pixel value of an image sensor, A comparison means to compute a centroid calculation means to compute the center of gravity of said histogram, and direction and size of the gap of the center of gravity of said histogram to the reference interval set up beforehand, Since it has an exposure control means which controls exposure so that the center of gravity of said histogram may enter in said reference interval based on direction and size of the gap of the center of gravity of said histogram to said reference interval, The number of times of an operation required for calculation of the center of gravity of a histogram can be made less than the number of times of an operation required for calculation of the average value of the output of the pixel of one screen,

And since histogram creation [redacted] the light processing of a grade which [redacted] can be performed also with a cheap arithmetic unit, it can reduce a synthetic processing load compared with the case where the average value of the output of the pixel of one screen is used for control.

[0030]

The invention of Claim 4 is provided with the histogram end elimination means in which the range and pixel value of constant width remove at least one side with the range of 0 to constant width from said histogram in the invention according to claim 3 from the maximum decided in the imaging device of a pixel value, Since said centroid calculation means computes the center of gravity of said histogram which said histogram end elimination means outputted, The phenomenon in which a photographic subject carries out black crushing when an extremely bright field exists in a screen, the phenomenon in which a photographic subject white-flies when an extremely dark field exists in a screen, etc. are prevented, and more suitable exposure control is attained. Since the number of times of the operation for computing the center of gravity of a histogram when the width of a histogram moreover becomes narrow becomes fewer, a processing load is reduced further.

[Brief Description of the Drawings]

[Drawing 1]It is a block diagram showing the embodiment of this invention.

[Drawing 2]It is an explanatory view of operation showing the same as the above.

[Drawing 3]It is an explanatory view showing an experimental result same as the above.

[Drawing 4]It is an explanatory view showing how to ask for the average of the output of a pixel in a conventional example.

[Description of Notations]

2 Histogram preparing means

3 Histogram end elimination means

4 Centroid calculation means

5 Comparison means

6 Exposure control means

C Imaging device

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is a block diagram showing the embodiment of this invention.

[Drawing 2]It is an explanatory view of operation showing the same as the above.

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[Description of Notations]

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5 Comparison means
6 Exposure control means
C Imaging device

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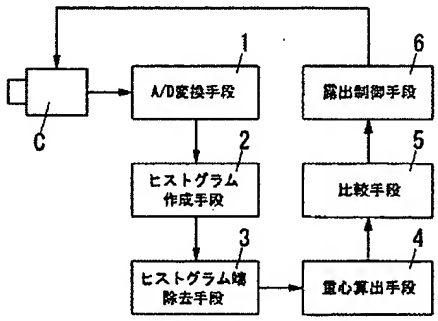
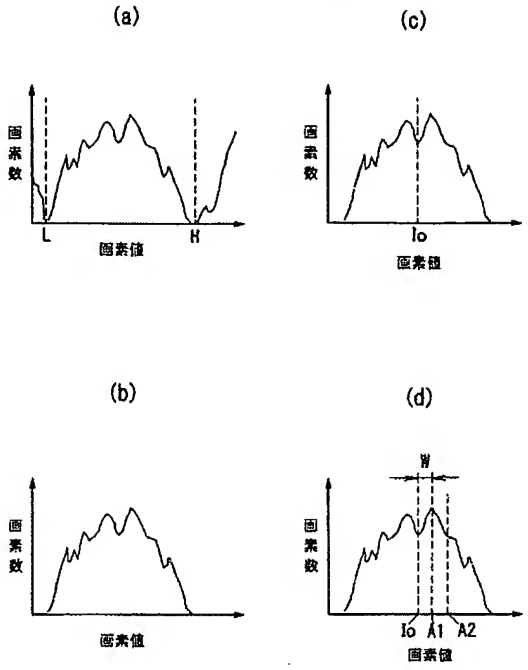
DRAWINGS

[Drawing 1]

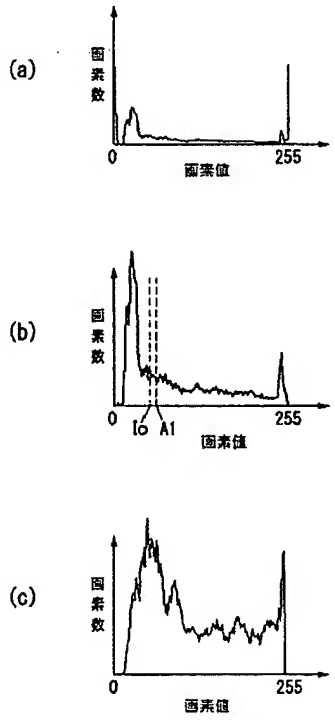
2 ヒストグラム作成手段
3 ヒストグラム端除去手段
4 重心算出手段
5 比較手段
6 露出制御手段
C 撮像装置



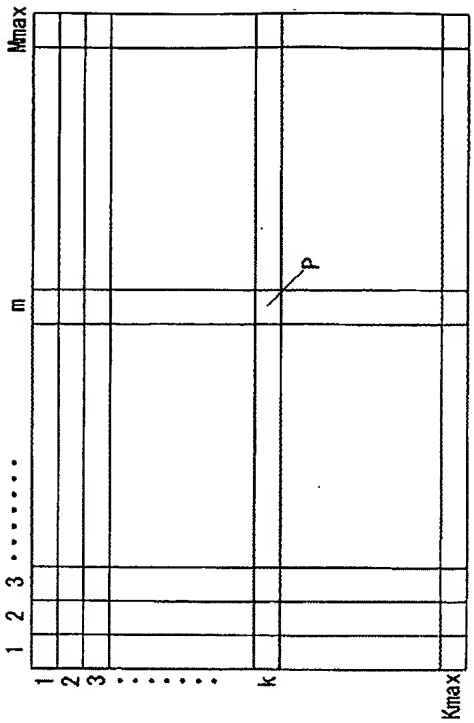
[Drawing 2]



[Drawing 3]



[Drawing 4]



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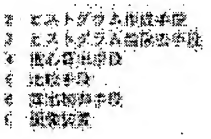
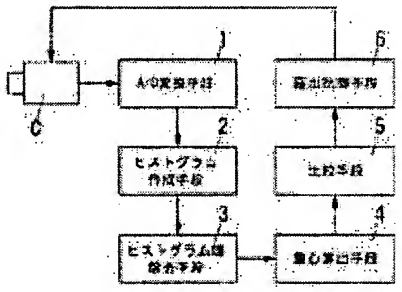
(54) METHOD AND DEVICE FOR EXPOSURE CONTROL

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a method and device for exposure control, which can reduce the processing loads.
SOLUTION: The method and device comprise a histogram creating means 2 for creating a histogram of the values of each pixel of an imaging device C, which is equipped with an image sensor having a plurality of pixels and can adjust exposure; a histogram edge removing means 3 for removing parts of the histogram; a centroid calculation means 4 for calculating the centroid of the histogram; a comparison means 5 for calculating the direction and the size of the shifting of the histogram's centroid from a predetermined reference range; and an exposure control means 6 for controlling the exposure so that the centroid falls within the reference range, based on the direction and size calculation. Since the frequencies of the operations required for calculating the centroid can be made fewer than those required for calculating the average value of pixel output for one screen, processing loads can be reduced, as compared with the case where the average value of pixel output for one screen is used for control.





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CLAIMS

[Claim(s)]
[Claim 1]
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[Claim 2]
The range of the maximum decided in an imaging device of a pixel value before computing the center of gravity of said histogram to constant width, and the exposure controlling method according to claim 1 with which a pixel value is characterized by removing at least one side with the range of constant width from said histogram from 0.
[Claim 3]
An exposure controller which is provided with an image sensor which has two or more pixels, and controls exposure of an imaging device which can adjust exposure, comprising:
A histogram preparing means which creates a histogram of a pixel value of an image sensor.
A centroid calculation means to compute the center of gravity of said histogram.
A comparison means to compute direction and a size of a gap of the center of gravity of said histogram to a reference interval set up beforehand.
An exposure control means which controls exposure so that the center of gravity of said histogram enters in said reference interval based on direction and a size of a gap of the center of gravity of said histogram to said reference interval.

[Claim 4]
A range and a pixel value of constant width are provided with a histogram end elimination means which removes at least one side with the range of 0 to constant width from said histogram from the maximum decided in an imaging device of a pixel value, The exposure controller according to claim 3, wherein said centroid calculation means computes the center of gravity of said histogram which said histogram end elimination means outputted.

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[Detailed Description of the Invention]
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[0002]

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However, as shown in drawing 4, the pixel number to which Kmax was located in a line with the length of the image sensor, the pixel number to which Mmax was located in a line beside the image sensor, and I (k, m) are the outputs of the left to the k-th and the m-th pixel P from a top. That is, the output of a pixel is added and the average Iaverage of the output of the pixel of one screen is computed by breaking by pixel number KmaxxMmax. In the image sensor (CCD element) of the imaging device (CCD camera) generally used, for example by the intercom with a camera, it is Kmax=240 and Mmax=320.
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This invention is made in view of the above-mentioned reason, and the purpose is to provide the exposure controlling method and exposure controller which can reduce a processing load.
[0009]
[Means for Solving the Problem]
An invention of Claim 1 is an exposure controlling method which is provided with an image sensor which has two or more pixels, and controls exposure of an imaging device which can adjust exposure, A histogram of a pixel value of an image sensor is created, the center of gravity of said histogram is computed, and exposure is controlled so that the center of gravity of said histogram enters in said reference interval based on direction and a size of a gap of the center of gravity of said histogram to a reference interval set up beforehand.
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[0011]

Exposure controller of this invention which is provided with an image sensor for which it has two or more pixels, and controls exposure of an imaging device which can adjust exposure is characterized by that an invention of Claim 3 comprises the following.

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[0012]

An invention of Claim 4 is provided with a histogram end elimination means in which a range and a pixel value of constant width remove at least one side with the range of 0 to constant width from said histogram in the invention according to claim 3 from the maximum decided in an imaging device of a pixel value, Said centroid calculation means computes the center of gravity of said histogram which said histogram end elimination means outputted.

[0013]

[Embodiment of the Invention]

Hereafter, an embodiment of the invention is described based on Drawings.

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This embodiment is what is provided with the image sensor which has two or more pixels, and controls exposure of the imaging device C (for example, CCD camera) which can adjust exposure, as shown in drawing 1, The A/D conversion means 1 which carries out the A/D conversion of the output of each pixel of the imaging device C, and the histogram preparing means 2 which creates a histogram based on the output of the A/D conversion means 1, The histogram end elimination means 3 which removes a part of histogram, and a centroid calculation means 4 to compute the center of gravity of a histogram, It has the exposure control means 6 which controls exposure so that the center of gravity of a histogram approaches a reference value based on a comparison means 5 to compute direction and size of the gap of the center of gravity of a histogram to the reference interval set up beforehand, and direction and size of the gap of the center of gravity of a histogram to a reference interval. The histogram preparing means 2, the histogram end elimination means 3, the centroid calculation means 4, the comparison means 5, and the exposure control means 6 are realized by arithmetic unit respectively like a microcomputer.

[0015]

If it explains in detail, the A/D conversion part 1 will carry out the A/D conversion of the output of each pixel, and will generate a pixel value. A pixel value is a discrete value corresponding by the maximum of the output of the pixel decided in the imaging device C from 0, for example, takes the integral value of 0-255. The histogram preparing means 2 creates the histogram which shows the pixel number to a pixel value as shown in drawing 2 (a).

[0016]

As the 2nd beforehand bigger threshold H than the 1st threshold L and the 1st threshold L is set to the histogram end elimination means 3 and it is shown in drawing 2 (b), a pixel value The range to the 0 to 1st threshold L, The range from the 2nd threshold H to the maximum (for example, 255) of a pixel value is removed from a histogram. Here, the 1st threshold L and the 2nd threshold H are set up according to the situation of the setting position of the imaging device C, etc. remain without removing the range of the high pixel value of a possibility of corresponding to a photographic subject.

[0017]

It is good also as composition which sets up the range to remove automatically periodically for

every photography instead of setting up the 1st threshold L and the 2nd threshold H beforehand. For example, make into the 1st threshold L the position of the valley in the position whose pixel value is higher than the peak in a position with the lowest pixel value, and let the position of the valley in the position whose pixel value is lower than the peak in a position with the highest pixel value be the 2nd threshold H.

[0018]

The centroid calculation means 4 computes center-of-gravity I_0 (refer to drawing 2 (c)) of the histogram which the histogram end elimination means 3 outputted by the lower type 2.

[0019]

[Equation 2]

$$I_0 = \frac{\sum_{i=L+1}^{H-1} i \cdot N(i)}{\sum_{i=L+1}^{H-1} N(i)} \quad \cdots \quad (式2)$$

[0020]

Here, N(i) is the number of the pixels which take the pixel value i.

[0021]

The comparison means 5 computes direction and size of a gap of center-of-gravity I_0 to the reference interval where the lower limit A1 and the upper limit A2 were set up beforehand, as shown in drawing 2 (d). For example, when center-of-gravity I_0 is lower than the lower limit A1 of a reference interval, the difference W of the lower limit A1 and center-of-gravity I_0 is computed.

[0022]

The exposure control means 6 controls exposure by controlling the amount of diaphragms and shutter speed of the imaging device C so that center-of-gravity I_0 enters in a reference interval.

[0023]

A result of having controlled based on center-of-gravity I_0 of a histogram shown in drawing 3 (b) which standardized and operated orthopedically so that both ends of a histogram shown in drawing 3 (a) might be removed in an experiment which an artificer conducted and the maximum of a pixel number might be set to 1, A histogram shown in drawing 3 (c) was obtained, and rationalization of exposure was checked.

[0024]

According to the above-mentioned composition, an operation performed after all for calculation of an arithmetic unit as the centroid calculation means 4 of the center of gravity to accumulate, Since it is with addition about [which was set as a pixel value to multiplication about / which was set as a pixel value to a numerator of the formula 2 / a number, and a numerator and a denominator of the formula 2, respectively] a number, and one division, the number of times of a required operation will be a number of at most about 3 times set as a pixel value in total. If about 256 steps of 0-255 are set to a pixel value as a result of an experiment which an artificer conducted, it turns out that the exposure control effect equivalent to a conventional method of averaging an output of a pixel of one screen is acquired. In that is, the case of an image sensor which has a pixel of about 100,000-300,000 like an image sensor carried in an imaging device used, for example by an intercom with television. An operation which an arithmetic unit used for this invention performs as the centroid calculation means 4 will not fulfill 1000 times with a conventional method of averaging an output of a pixel of one screen in total to performing about 100,000 times - 300,000 operations, either. Since histogram creation is the light processing of a grade which can be performed also with a cheap arithmetic unit, a processing load is reduced

synthetically.
[0025]
Therefore, when a burden to an arithmetic unit decreases, control of exposure accelerates, Since flattery nature to change of a luminosity of a picture improves, it is suitable for imaging devices installed in environment where a luminosity of a picture changes easily, such as a camera, a camera of an intercom with television, a surveillance camera, etc. which are installed in the door of collective housing, such as an apartment. Or though flattery nature equivalent to the former is maintained, cost can be lowered using an arithmetic unit of a low speed cheaper than an arithmetic unit used conventionally. A required memory decreases by reducing a processing load.
[0026]
Since the histogram end elimination means 3 is established, a phenomenon in which a photographic subject carries out black crushing when an extremely bright field exists in a screen, a phenomenon in which a photographic subject white-flies when an extremely dark field exists in a screen, etc. are prevented, and more suitable exposure control is attained. Since the number of times of an operation for computing the center of gravity of a histogram compared with a case where the histogram end elimination means 3 moreover is not established when width of a histogram becomes narrow becomes fewer, a processing load is reduced further.
[0027]
[Effect of the Invention]
The invention of Claim 1 is an exposure controlling method which is provided with the image sensor which has two or more pixels, and controls exposure of the imaging device which can adjust exposure, Create the histogram of the pixel value of an image sensor and the center of gravity of said histogram is computed, Since exposure is controlled so that the center of gravity of said histogram enters in said reference interval based on direction and size of the gap of the center of gravity of said histogram to the reference interval set up beforehand, The number of times of an operation required for calculation of the center of gravity of a histogram can be made less than the number of times of an operation required for calculation of the average value of the output of the pixel of one screen, And since histogram creation is the light processing of a grade which can be performed also with a cheap arithmetic unit, it can reduce a synthetic processing load compared with the case where the average value of the output of the pixel of one screen is used for control.
[0028]
The range of the maximum decided in the imaging device of a pixel value before the invention of Claim 2 computes the center of gravity of said histogram in the invention according to claim 1 to constant width, From 0, since a pixel value removes at least one side with the range of constant width from said histogram, The phenomenon in which a photographic subject carries out black crushing when an extremely bright field exists in a screen, the phenomenon in which a photographic subject white-flies when an extremely dark field exists in a screen, etc. are prevented, and more suitable exposure control is attained. Since the number of times of the operation for computing the center of gravity of a histogram when the width of a histogram moreover becomes narrow becomes fewer, a processing load is reduced further.
[0029]
The histogram preparing means which the invention of Claim 3 is an exposure controller which is provided with the image sensor which has two or more pixels, and controls exposure of the imaging device which can adjust exposure, and creates the histogram of the pixel value of an image sensor, A comparison means to compute a centroid calculation means to compute the center of gravity of said histogram, and direction and size of the gap of the center of gravity of said histogram to the reference interval set up beforehand, Since it has an exposure control means which controls exposure so that the center of gravity of said histogram may enter in said reference interval based on direction and size of the gap of the center of gravity of said histogram to said reference interval, The number of times of an operation required for calculation of the center of gravity of a histogram can be made less than the number of times of an operation required for calculation of the average value of the output of the pixel of one screen,

And since histogram creation [redacted] the light processing of a grade which [redacted] n be performed also with a cheap arithmetic unit, it can reduce a synthetic processing load compared with the case where the average value of the output of the pixel of one screen is used for control.

[0030]

The invention of Claim 4 is provided with the histogram end elimination means in which the range and pixel value of constant width remove at least one side with the range of 0 to constant width from said histogram in the invention according to claim 3 from the maximum decided in the imaging device of a pixel value, Since said centroid calculation means computes the center of gravity of said histogram which said histogram end elimination means outputted, The phenomenon in which a photographic subject carries out black crushing when an extremely bright field exists in a screen, the phenomenon in which a photographic subject white-flies when an extremely dark field exists in a screen, etc. are prevented, and more suitable exposure control is attained. Since the number of times of the operation for computing the center of gravity of a histogram when the width of a histogram moreover becomes narrow becomes fewer, a processing load is reduced further.

[Brief Description of the Drawings]

[Drawing 1]It is a block diagram showing the embodiment of this invention.

[Drawing 2]It is an explanatory view of operation showing the same as the above.

[Drawing 3]It is an explanatory view showing an experimental result same as the above.

[Drawing 4]It is an explanatory view showing how to ask for the average of the output of a pixel in a conventional example.

[Description of Notations]

2 Histogram preparing means

3 Histogram end elimination means

4 Centroid calculation means

5 Comparison means

6 Exposure control means

C Imaging device

[Translation done.]

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DESCRIPTION OF DRAWINGS

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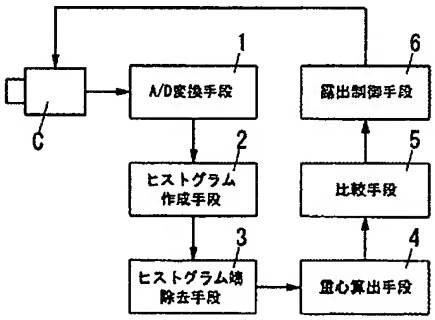
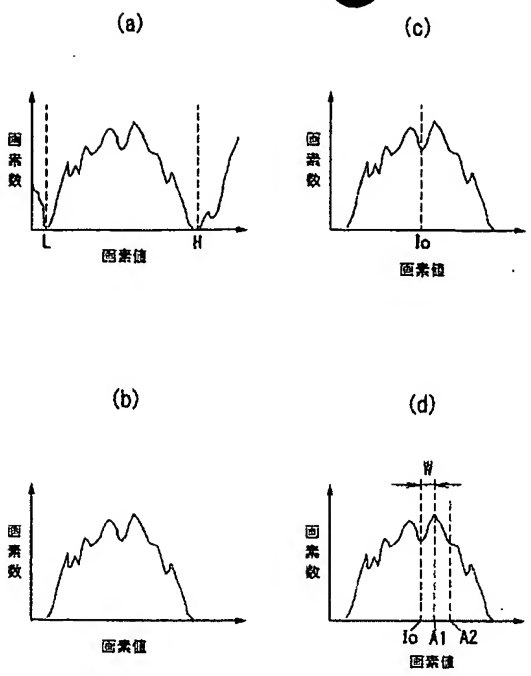
DRAWINGS

[Drawing 1]

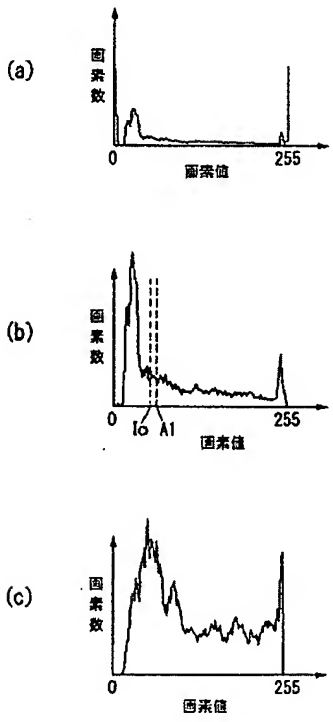
2 ヒストグラム作成手段
3 ヒストグラム端除去手段
4 重心算出手段
5 比較手段
6 露出制御手段
C 撮像装置



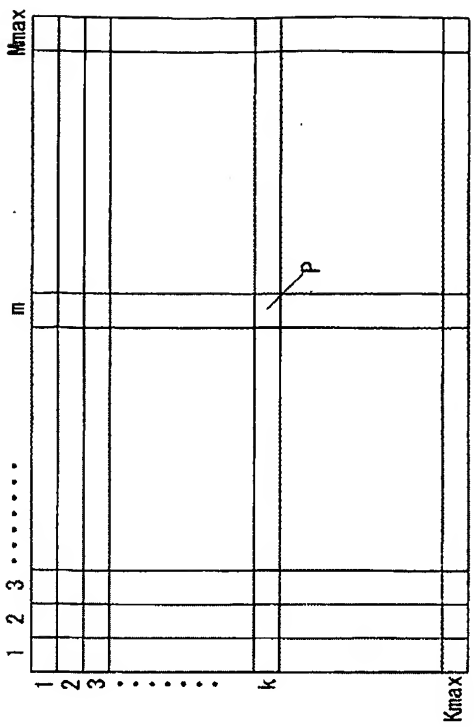
[Drawing 2]



[Drawing 3]



[Drawing 4]



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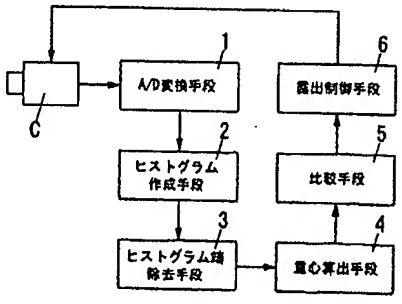
5C024 BX04 GY01 HX21 HX28 HX30

(54)【発明の名称】露出制御方法及び露出制御装置

(57)【要約】
【課題】処理負荷を軽減することができる露出制御方法及び露出制御装置を提供する。
【解決手段】複数の画素を有する撮像素子を備え露出の調整が可能な撮像装置Cの各画素の画素値のヒストグラムを作成するヒストグラム作成手段２と、ヒストグラムの一部を除去するヒストグラム端除去手段３と、ヒストグラムの重心を算出する重心算出手段４と、予め設定された基準範囲に対するヒストグラムの重心のずれの向きと大きさとを算出する比較手段５と、基準範囲に対するヒストグラムの重心のずれの向きと大きさとに基づいてヒストグラムの重心が基準範囲内に入るように露出を制御する露出制御手段６とを備える。ヒストグラムの重心の算出に必要な演算の回数は、一画面の画素の出力の平均値の算出に必要な演算の回数よりも少なくすることができるから、一画面の画素の出力の平均値を制御に用いる場合と比べ、処理負荷を軽減することができる。
【選択図】 図１

2 ヒストグラム作成手段
3 ヒストグラム端除去手段
4 重心算出手段
5 比較手段
6 露出制御手段
C 撮像装置



【特許請求の範囲】
【請求項１】
複数の画素を有する撮像素子を備え露出の調整が可能な撮像装置の露出を制御する露出制御方法であって、撮像素子の画素値のヒストグラムを作成し、前記ヒストグラムの重心を算出し、予め設定された基準範囲に対する前記ヒストグラムの重心のずれの向きと大きさとに基づいて前記ヒストグラムの重心が前記基準範囲内に入るように露出を制御することを特徴とする露出制御方法。
【請求項２】
前記ヒストグラムの重心を算出する前に、画素値の撮像装置において決まる最大値から一定幅の範囲と、画素値が０から一定幅の範囲との少なくとも一方を前記ヒストグラムから除去することを特徴とする請求項１記載の露出制御方法。
【請求項３】
複数の画素を有する撮像素子を備え露出の調整が可能な撮像装置の露出を制御する露出制御装置であって、撮像素子の画素値のヒストグラムを作成するヒストグラム作成手段と、前記ヒストグラムの重心を算出する重心算出手段と、予め設定された基準範囲に対する前記ヒストグラムの重心のずれの向きと大きさとを算出する比較手段と、前記基準範囲に対する前記ヒストグラムの重心のずれの向きと大きさとに基づいて前記ヒストグラムの重心が前記基準範囲内に入るように露出を制御する露出制御手段とを備えることを特徴とする露出制御装置。
【請求項４】
画素値の撮像装置において決まる最大値から一定幅の範囲と画素値が０から一定幅の範囲との少なくとも一方を前記ヒストグラムから除去するヒストグラム端除去手段を備え、前記重心算出手段は前記ヒストグラム端除去手段が出力した前記ヒストグラムの重心を算出することを特徴とする請求項３記載の露出制御装置。

【発明の詳細な説明】
【０００１】
【発明の属する技術分野】
本発明は、複数の画素を有する撮像素子を備え露出の調整が可能な撮像装置の露出を制御する露出制御方法及び露出制御装置に関するものである。
【０００２】
【従来の技術】
従来から、複数の画素を有する撮像素子を備え露出の調整が可能な撮像装置の露出を制御する露出制御方法として、画素が出力する輝度信号（以下、単に「画素の出力」と呼ぶ）の一画面分の平均が基準値に近付くように露出を制御する露出制御方法が提案されている（例えば、特許文献１及び特許文献２参照）。
【０００３】
一画面の画素の出力の平均Ｉａｖｅｒａｇｅは、例えば演算装置を用いて下式１で算出していた。
【０００４】
【数１】

$$Iaverage = \frac{\sum_{k=1}^{K\max}\sum_{m=1}^{M\max} I(k,m)}{K\max \times M\max} \quad \cdots \text{（式１）}$$

【０００５】
ただし、図４に示すように、Ｋｍａｘは撮像素子の縦に並んだ画素数、Ｍｍａｘは撮像素子の横に並んだ画素数、Ｉ（ｋ，ｍ）は上からｋ番目、左からｍ番目の画素Ｐの出力である。つまり、画素の出力を加算し、画素数Ｋｍａｘ×Ｍｍａｘで割ることによって一画面の画素の出力の平均Ｉａｖｅｒａｇｅを算出している。なお、例えばカメラ付ドアホンで

一般的に使用されている撮像装置（ＣＣＤカメラ）の撮像素子（ＣＣＤ素子）では、Ｋｍａｘ＝２４０、Ｍｍａｘ＝３２０である。

【０００６】

【特許文献１】

特開平５－２０７３６１号公報（第４頁）

【特許文献２】

特開平６－４６３２５号公報（第６頁）

【０００７】

【発明が解決しようとする課題】

しかし、上記従来の露出制御方法においては、一画面の画素の出力の平均を算出するために、画素数と同じ回数の演算を行う必要がある。上で例に挙げた撮像装置の場合、加算が（２４０×３２０－１）回と除算が１回とで、合計７６８００回もの演算が必要となる。従って、演算装置に大きな負荷がかかり、露出の制御が遅くなって画像の変化への追従性が悪くなっていた。

【０００８】

本発明は上記事由に鑑みてなされたものであり、その目的は、処理負荷を軽減することができる露出制御方法及び露出制御装置を提供することにある。

【０００９】

【課題を解決するための手段】

請求項１の発明は、複数の画素を有する撮像素子を備え露出の調整が可能な撮像装置の露出を制御する露出制御方法であって、撮像素子の画素値のヒストグラムを作成し、前記ヒストグラムの重心を算出し、予め設定された基準範囲に対する前記ヒストグラムの重心のずれの向きと大きさとに基づいて前記ヒストグラムの重心が前記基準範囲内に入るように露出を制御することを特徴とする。

【００１０】

請求項２の発明は、請求項１記載の発明において、前記ヒストグラムの重心を算出する前に、画素値の撮像装置において決まる最大値から一定幅の範囲と、画素値が０から一定幅の範囲との少なくとも一方を前記ヒストグラムから除去することを特徴とする。

【００１１】

請求項３の発明は、複数の画素を有する撮像素子を備え露出の調整が可能な撮像装置の露出を制御する露出制御装置であって、撮像素子の画素値のヒストグラムを作成するヒストグラム作成手段と、前記ヒストグラムの重心を算出する重心算出手段と、予め設定された基準範囲に対する前記ヒストグラムの重心のずれの向きと大きさとを算出する比較手段と、前記基準範囲に対する前記ヒストグラムの重心のずれの向きと大きさとに基づいて前記ヒストグラムの重心が前記基準範囲内に入るように露出を制御する露出制御手段とを備えることを特徴とする。

【００１２】

請求項４の発明は、請求項３記載の発明において、画素値の撮像装置において決まる最大値から一定幅の範囲と画素値が０から一定幅の範囲との少なくとも一方を前記ヒストグラムから除去するヒストグラム端除去手段を備え、前記重心算出手段は前記ヒストグラム端除去手段が出力した前記ヒストグラムの重心を算出することを特徴とする。

【００１３】

【発明の実施の形態】

以下、本発明の実施の形態を図面に基づいて説明する。

【００１４】

本実施形態は、図１に示すように、複数の画素を有する撮像素子を備え露出の調整が可能な撮像装置Ｃ（例えばＣＣＤカメラ）の露出を制御するものであって、撮像装置Ｃの各画素の出力をＡ／Ｄ変換するＡ／Ｄ変換手段１と、Ａ／Ｄ変換手段１の出力に基づいてヒストグラムを作成するヒストグラム作成手段２と、ヒストグラムの一部を除去するヒストグラム端除去手段３と、ヒストグラムの重心を算出する重心算出手段４と、予め設定された

基準範囲に対するヒストグラムの重心のずれの向きと大きさとを算出する比較手段５と、基準範囲に対するヒストグラムの重心のずれの向きと大きさとに基づいてヒストグラムの重心が基準値に近付くように露出を制御する露出制御手段６とを備える。ヒストグラム作成手段２と、ヒストグラム端除去手段３と、重心算出手段４と、比較手段５と、露出制御手段６とはそれぞれマイコンのような演算装置によって実現される。

【００１５】

詳しく説明すると、Ａ／Ｄ変換部１は各画素の出力をＡ／Ｄ変換して画素値を生成する。画素値は、０から撮像装置Ｃにおいて決まる画素の出力の最大値までに対応する離散値であって、例えば０～２５５の整数値をとる。ヒストグラム作成手段２は、図２（ａ）に示すように画素値に対する画素数を示すヒストグラムを作成する。

【００１６】

ヒストグラム端除去手段３には、予め第１の閾値Ｌと、第１の閾値Ｌよりも大きな第２の閾値Ｈとが設定されており、図２（ｂ）に示すように画素値が０から第１の閾値Ｌまでの範囲と、第２の閾値Ｈから画素値の最大値（例えば２５５）までの範囲とをヒストグラムから除去する。ここで、第１の閾値Ｌと第２の閾値Ｈとは、被写体に対応する可能性の高い画素値の範囲が除去されずに残るように、撮像装置Ｃの設置場所の状況等に合わせて設定される。

【００１７】

なお、第１の閾値Ｌと第２の閾値Ｈとを予め設定する代わりに、撮影毎に又は定期的に、除去する範囲を自動的に設定する構成としてもよい。例えば、最も画素値が低い位置にあるピークよりも画素値が高い位置にある谷の位置を第１の閾値Ｌとし、最も画素値が高い位置にあるピークよりも画素値が低い位置にある谷の位置を第２の閾値Ｈとする。

【００１８】

重心算出手段４は、ヒストグラム端除去手段３が出力したヒストグラムの重心Ｉ。（図２（ｃ）参照）を、下式２によって算出する。

【００１９】

【数２】

$$I_0 = \frac{\sum_{i=L+1}^{H-1} i \cdot N(i)}{\sum_{i=L+1}^{H-1} N(i)} \quad \cdots \text{（式２）}$$

【００２０】

ここで、Ｎ（ｉ）は画素値ｉをとる画素の数である。

【００２１】

比較手段５は、図２（ｄ）に示すように、予め下限値Ａ１と上限値Ａ２とが設定された基準範囲に対する重心Ｉ。のずれの向きと大きさとを算出する。例えば重心Ｉ。が基準範囲の下限値Ａ１よりも低かった場合、下限値Ａ１と重心Ｉ。との差Ｗを算出する。

【００２２】

露出制御手段６は、重心Ｉ。が基準範囲内に入るように撮像装置Ｃの絞り量やシャッタースピードを制御することによって露出を制御する。

【００２３】

発明者が行った実験において、図３（ａ）に示すヒストグラムの両端部を除去して画素数の最大値を１とするように規格化して整形した図３（ｂ）に示すヒストグラムの重心Ｉ。に基づいて制御を行った結果、図３（ｃ）に示すヒストグラムが得られ、露出の適正化が確認された。

【００２４】

上記構成によれば、結局、重心算出手段４としての演算装置が重心の算出のために行う演

算は、式２の分子に対して画素値に設定した数程度の乗算と、式２の分子と分母とに対してそれぞれ画素値に設定した数程度の加算と、１回の除算とであるので、必要な演算の回数は合計で画素値に設定した数の高々３倍程度となる。また、発明者が行った実験の結果、画素値には０～２５５の２５６段階程度を設定すれば、一画面の画素の出力を平均する従来の方法と同等の露出制御効果が得られることが分かっている。つまり、例えばテレビ付ドアホンで用いられる撮像装置に搭載される撮像素子のようにおよそ１０万～３０万の画素を有する撮像素子の場合、一画面の画素の出力を平均する従来の方法ではおよそ１０万回～３０万回もの演算を行う必要があるのに対し、本発明に用いられる演算装置が重心算出手段４として行う演算は合計で１０００回にも満たないことになる。また、ヒストグラム作成は安価な演算装置でも行うことのできる程度の軽い処理であるから、総合的には処理負荷が軽減される。

【００２５】

従って、演算装置への負担が減少することにより露出の制御が高速化し、画像の明るさの変化への追従性が向上するから、マンションなどの集合住宅の玄関に設置されるカメラや、テレビ付きドアホンのカメラや、監視カメラなど、画像の明るさが変化しやすい環境に設置される撮像装置に好適である。または、従来と同等の追従性を維持しながらも従来用いられた演算装置よりも安価な低速の演算装置を用いてコストを下げることができる。また、処理負荷が軽減されることにより、必要なメモリが少なくなる。

【００２６】

また、ヒストグラム端除去手段３が設けられているから、画面内に極端に明るい領域が存在するときに被写体が黒つぶれする現象や、画面内に極端に暗い領域が存在するときに被写体が白とびする現象などが防止され、より適切な露出制御が可能となる。その上、ヒストグラム端除去手段３を設けない場合に比べ、ヒストグラムの幅が狭くなることにより、ヒストグラムの重心を算出するための演算の回数が減るから、さらに処理負荷が軽減される。

【００２７】

【発明の効果】

請求項１の発明は、複数の画素を有する撮像素子を備え露出の調整が可能な撮像装置の露出を制御する露出制御方法であって、撮像素子の画素値のヒストグラムを作成し、前記ヒストグラムの重心を算出し、予め設定された基準範囲に対する前記ヒストグラムの重心のずれの向きと大きさとに基づいて前記ヒストグラムの重心が前記基準範囲内に入るように露出を制御するので、ヒストグラムの重心の算出に必要な演算の回数は一画面の画素の出力の平均値の算出に必要な演算の回数よりも少なくすることができ、かつヒストグラム作成は安価な演算装置でも行うことのできる程度の軽い処理であるから、一画面の画素の出力の平均値を制御に用いる場合に比べ、総合的な処理負荷を軽減することができる。

【００２８】

請求項２の発明は、請求項１記載の発明において、前記ヒストグラムの重心を算出する前に、画素値の撮像装置において決まる最大値から一定幅の範囲と、画素値が０から一定幅の範囲との少なくとも一方を前記ヒストグラムから除去するので、画面内に極端に明るい領域が存在するときに被写体が黒つぶれする現象や、画面内に極端に暗い領域が存在するときに被写体が白とびする現象などが防止され、より適切な露出制御が可能となる。その上、ヒストグラムの幅が狭くなることにより、ヒストグラムの重心を算出するための演算の回数が減るから、さらに処理負荷が軽減される。

【００２９】

請求項３の発明は、複数の画素を有する撮像素子を備え露出の調整が可能な撮像装置の露出を制御する露出制御装置であって、撮像素子の画素値のヒストグラムを作成するヒストグラム作成手段と、前記ヒストグラムの重心を算出する重心算出手段と、予め設定された基準範囲に対する前記ヒストグラムの重心のずれの向きと大きさとを算出する比較手段と、前記基準範囲に対する前記ヒストグラムの重心のずれの向きと大きさとに基づいて前記ヒストグラムの重心が前記基準範囲内に入るように露出を制御する露出制御手段とを備え

るので、ヒストグラムの重心の算出に必要な演算の回数は一画面の画素の出力の平均値の算出に必要な演算の回数よりも少なくすることができ、かつヒストグラム作成は安価な演算装置でも行うことのできる程度の軽い処理であるから、一画面の画素の出力の平均値を制御に用いる場合に比べ、総合的な処理負荷を軽減することができる。

【００３０】

請求項４の発明は、請求項３記載の発明において、画素値の撮像装置において決まる最大値から一定幅の範囲と画素値が０から一定幅の範囲との少なくとも一方を前記ヒストグラムから除去するヒストグラム端除去手段を備え、前記重心算出手段は前記ヒストグラム端除去手段が出力した前記ヒストグラムの重心を算出するので、画面内に極端に明るい領域が存在するときに被写体が黒つぶれする現象や、画面内に極端に暗い領域が存在するときに被写体が白とびする現象などが防止され、より適切な露出制御が可能となる。その上、ヒストグラムの幅が狭くなることにより、ヒストグラムの重心を算出するための演算の回数が減るから、さらに処理負荷が軽減される。

【図面の簡単な説明】

【図１】本発明の実施形態を示すブロック図である。

【図２】同上を示す動作説明図である。

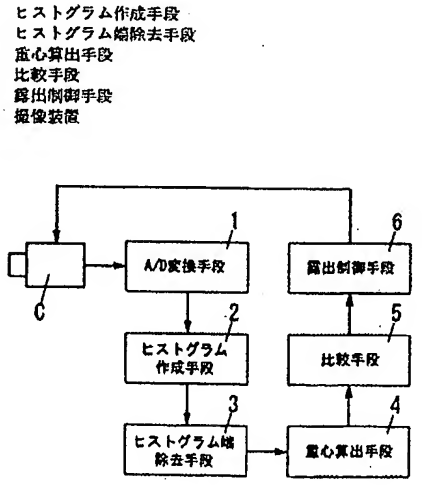
【図３】同上の実験結果を示す説明図である。

【図４】従来例において画素の出力の平均を求める方法を示す説明図である。

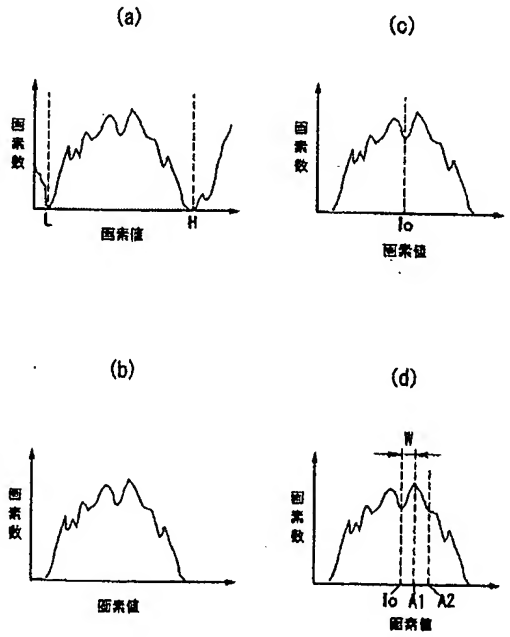
【符号の説明】

2　ヒストグラム作成手段
3　ヒストグラム端除去手段
4　重心算出手段
5　比較手段
6　露出制御手段
C　撮像装置

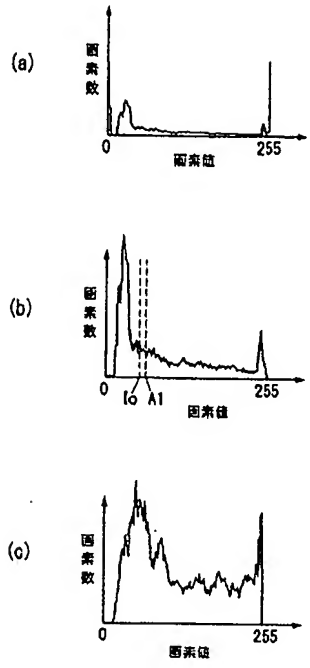
【図1】



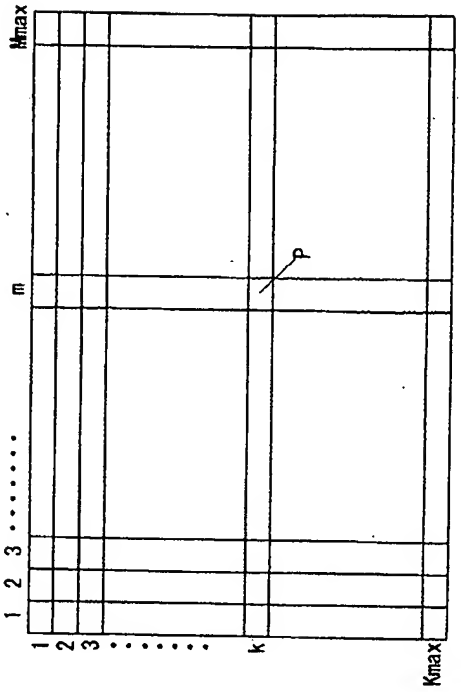
【図2】



【図３】


(a)
画素数
0
255
画素値
(b)
画素数
0
t0
A1
255
画素値
(c)
画素数
0
255
画素値

【図４】


Mmax
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1 2 3 ・・・・・・・
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Kmax